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An insight on the greenhouse gas emission from the metals process industries and its effects on climate change

Abstract

This article presents the research outcomes published in various scientific journals on problems and solutions of carbon emission from metals process industries. This paper has focused on potential metals process industries, which are associated with economic development and as well as are responsible for a significant amount of carbon emission. To achieve the goals of the study, the methodology has developed for collecting required information from the relevant journals published in the years 1990 to 2019 for supporting to the ongoing global activities in achieving sustainable development and to mitigate climate change effects. The study revealed that the Steel, Aluminium, Copper, Zinc, and Magnesium process industries are the potential Greenhouse Gas emission sources including Carbon-dioxide, Methane, and Nitrogen dioxide gases. The reported carbon concentration in the Atmosphere was 242ppm in 2018, 404ppm in 2017, 365.48ppm in 2000 and 354.19ppm in 1990. However, if this trend continues, the carbon concentration in the air would be 465 ppm in 2050 and about 700 ppm in 2100, which may increase further earth surface temperature from 3.7°C to 7.8°C. At the global level, the estimated carbon emission from manufacturing industries was about 42 percent which was accounted for 21.5Gt in 2018, 19.32Gt in 2017, 13.8Gt in 2015, and 10.5Gt in 2000.It was reported that the relevant stakeholders made required strategies to keep temperature increase well below 2°C with respect to the Pre-industrial level by reducing carbon emission; and in that aspect, the metals processing industries could play a vital role. This study also revealed that nowadays, a few technologies are available and these would be the part of metals processing industries to reduce carbon emission.This study found that the metals process industries indeed are a potential part of the global carbon emission, and contributing to increasing global warming and climate change. The study concludes that this article indeed would be a potential reference for future researches in this the field in developing models for reducing carbon emission from metal process industries toward mitigating climate change effects.

Keywords: climate change, engineering contribution, metals process, carbon capture, carbon emission

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Abbreviations: GHG, Greenhouse Gas; GWP, global warming potentials; F-gases, Fluorinated gases

Introduction

The metals process the industry is a source of Greenhouse Gas (GHG), and the major components of these gases are CO_2, CH_4, N_2O and Fluorinated gases (F-gases). The GHG is responsible for global warming potentials (GWP) and climate change.[1,2] However, the common source of GHG emission is electricity production from fossil fuel to operate metals industries and as well from metals processing.[3] The carbon dioxide in the atmosphere is about 65 percent.[4] The methane is the second-largest carbon in GHG after CO_2, which accounted for 16 percent of global emission. The effect of CH_4 on GWP and climate change is about 25 percent higher than CO_2.[5,6] Nitrous oxide is also a part of GHG in the atmosphere, and its contribution to GHG is about 6 percent. It has been reported that the metal process industries are a major emission source of N_2O.[7,8]The Fluorinated gas is a part of GHG and has a significant effect on climate change. The fact is the process of the metal industries are associated with Fluorinated gas emission. This gas includes hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride SF6.[9,10] The Magnesium (Mg), Zinc, Lead, and other metals processing industries are the emitter of this gas.[11] However, in a report, IEA stated that the burning of fossil fuel for electricity production to operate heavy industries like Iron, and Aluminum, Zinc. Magnesium and copper and significantly responsible for GWP.[4,12]

Operations of metals process industries and problem in managing enviromental pollutions

The metals process industries are responsible for a significant amount of carbon emission. The Steel, Aluminium, Copper, Zinc, and Magnesium process industries are the emitting sources of Carbon-dioxide, Methane, and Nitrogen dioxide gases. The reported carbon concentration in the atmosphere was 242ppm in 2018, 404ppm in 2017, 365.48ppm in 2000 and 354.19ppm in 1990; and the metals process industries, indeed, a contributor to that carbon concentration. It indicates that a problem exists in operations of metals process industries in controlling GHG emission, and the required efforts are not putting in place to solve it. The strategic goal of this paper is to list the emission level of the major metals process industries with relevant sustainable solutions.

Objective

The broad objective of this paper is to present information that